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A New Species and Variety of *Bolbitis* from India

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Recently a detailed morphological study of the genus *Bolbitis* was undertaken by the Pteridology Laboratory of the National Botanic Gardens (India), and in this connection several species of the genus from different parts of India were collected and studied (Nayar, 1960; Kaur, 1962). During November and December, 1962, two new types of *Bolbitis* were collected from the Castle Rock area in the Western Ghats of South India. They were transferred to the fernery of the National Botanic Gardens at Lucknow, along with specimens of *Bolbitis presliana*, *B. semicordata*, *B. subcrenata*, and *B. virens*. One of them matches *B. semicordata* (Moore) Ching, except that its rachis and stipe are narrowly winged and the margins of the pinnae are conspicuously lobed. It is described as a variety of *B. semicordata*.

The other is a large fern forming extensive colonies on gravelly soil on the western slopes of the hills in deep shade. This appears to be an unrecorded species and is described below. Herbarium specimens of both new ferns are deposited in the Herbarium of the National Botanic Gardens, Lucknow, India.

BOLBITIS kanarensis Nayar & Chandra, sp. nov.

Rhizoma repens ca. 2.5 cm. diam., crassum dense paleaceum, filis sclerenchymatis in pulpa centrali dissitis praeditum; paleae atrofuscae lanceolatae, basi auriculatae, acuminatae, glandulosociliatae; folia bifaria alterna in dorso rhizomatis; frondes steriles ca. 150 cm. longae, pinnatae, apice elongato linguliformi pen-

duli apice bulbifero; stipes usque ad 60 cm. longus, tetragonus, latere adaxiali bicanaliculatus, canalibus in rhachi continuis, basi dense paleatus, aerophoris cariniformibus lateralibus praeditus; pinnae laterales numerosae, inferiores breviter petiolulatae, superiores sessiles, supremae coadunatae, lanceolatae, ca. 25×2.5 cm., non gemmiferae, apice acuminatae serratae, basi late cuneatae, margine irregulariter undulatae; lamina plus minusve coriacea, supra atroviridis lucens, subtus pilis atrofusis parvis sparsis praedita; venae laterales 30–40-jugae (apice excluso) fere usque ad marginem distinctae, venulis secundariis 3 vel 4 utrinque latere, venulis 2 basalibus (raro 3) anastomosantibus, areolis goniopteroideis venulis excurrentibus 1–3 liberis vel unitis et ita areolis primariis in areolis secundariis 2 vel 3 divisis; frondes fertiles usque ad 100 cm. longae (stipite 40 cm. longo incluso), pinnis $10 \times 0.2\text{--}0.3$ cm., linearibus, apice obtusis, terminalibus coadunatis plus minusve prolongatis et saepe gemmiferis; sporae bilaterales $32 \times 42 \times 32 \mu$, perino rugoso psilato, exino psilato.

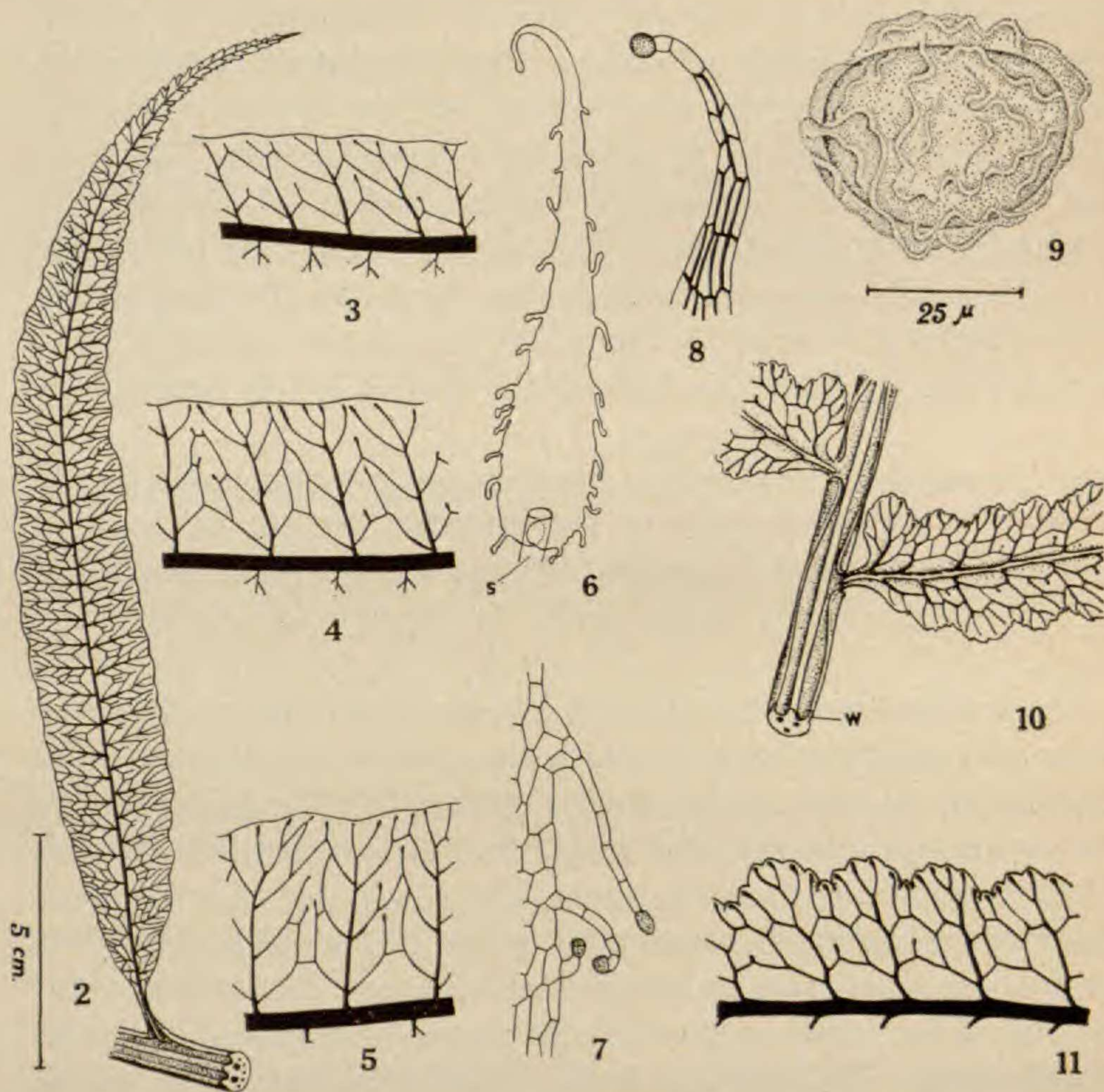
Type in the herbarium of the National Botanic Gardens, Lucknow, India, collected at Gudkewadi, Castle Rock, North Kanara, Mysore, India, alt. 400 meters, Dec. 9, 1962, *P. Chandra* 95146.

Bolbitis kanarensis (Fig. 1) is a large fern, restricted to deeply shaded, moist localities, growing on gravelly soil and forming large colonies on account of its "walking habit." The rhizome is short-creeping, tenaciously attached to the substratum by strong, wiry roots; it is soft, ca. 2.5 cm. thick, and densely paleaceous. The paleae are dark-brown, lanceolate (Fig. 6), acuminate, gland-tipped (Fig. 8) ca. 6 mm. long, basally attached by a broad flat stalk, with small but overlapping basal auricles, and bearing many elongated, multicellular, uniseriate, gland-tipped hairs (Fig. 7) along the margin. The rhizome is parenchymatous, but a few, slender, dark-brown, irregularly cylindrical sclerenchyma strands occur scattered in the pith; sclerenchyma strands generally are absent in the cortex. The stelar cylinder of the rhizome is composed of a broad, slightly curved, ribbon-like, ventral vascular strand and a small, cylindrical dorsal one separated from each other by large, broad, closely placed leaf gaps which alternate on either side. The leaves are in two closely placed alternating rows on the dorsal surface of the rhizome, and a



FIGURE 1. PHOTOGRAPH OF TYPE SPECIMEN OF *BOLBITIS KANARENSIS* NAYAR & CHANDRA, SP. NOV.

prominent lateral bud is associated with each leaf base on the side away from the median line of the rhizome. The sterile fronds are large, pinnate, upwardly spreading, and with a long, ribbon-like, terminal pinna which often reaches the substratum and roots at the tip. The stipe is up to 60 cm. long and 5 to 6 mm. thick, densely paleate at the base, glossy green and sparsely paleaceous upward, tetragonal (with smoothly rounded corners), and with two closely placed, parallel, adaxial grooves separated by a prominent, slender median ridge. The ridge becomes inconspicuous and the grooves merge into one broad, shallow depression toward the base of the stipe. A pair of prominent, discolored, thin, ridge-like aerating bands (more prominent at the base) occur on both lateral surfaces of the stipe. The lamina is lanceolate in outline. The rachis is up to 80 cm. long, green, sparsely paleaceous, and possesses two broad adaxial grooves separated by a prominent median ridge. The lateral pinnae are numerous, in alternate to subopposite pairs, more or less loosely placed and attached to the lateral margins of the adaxial grooves on either side. The basal pinnae are short-stalked (the stalk 5 mm. long and with a slightly dilated base); the upper are sessile and gradually reduced in size toward the apex of the leaf, the uppermost few pairs being coadunate with the terminal pinna. The larger lateral pinnae are 25×2.5 cm., lanceolate (Fig. 2) and with attenuated, long-acuminate, serrate apices, irregularly wavy margins, and broadly cuneate bases. They are deep green in color, coriaceous in texture, and glabrous above, but bearing brown, glandular hairs all over the lamina and small paleae along the main veins on the lower surface. The midrib is strongly raised on the lower surface; it bears (excluding the acuminate apex of the pinna) 30 to 40 pairs of lateral veins more or less horizontally (Fig. 2). The lateral veins are distinct to the margin of the lamina and bear three to four subopposite or alternate pairs of obliquely placed secondary veins (Figs. 3-5). The basal secondary veins unite in pairs forming two (rarely three) rows of goniopteroid areoles, with one, or usually more, excurrent veinlets in each. The secondary veins are free toward the mar-



FIGURES 2-9, *BOLBITIS KANARENSIS*; 10-11, *B. SEMICORDATA* VAR. *INCISA*. FIGURE 2. LATERAL PINNA. FIGS. 3-5. PARTS OF LAMINA, FIG. 3, FROM NEAR APEX; FIG. 4, NEAR MIDDLE; FIG. 5, NEAR BASE OF PINNA. FIG. 6. PALEA (s, STALK). FIG. 7. MARGIN OF YOUNG PALEA BEARING GLANDULAR HAIRS. FIG. 8. APEX OF MATURE PALEA. FIG. 9. SPORE, EQUATORIAL VIEW. FIG. 10. PART OF RACHIS SHOWING ATTACHMENT OF PINNAE AND WINGS (w) OF RACHIS. FIG. 11. VENATION PATTERN OF PART OF STERILE PINNA OF *B. SEMICORDATA* VAR. *INCISA*.

gin and their apices are clavate. The excurrent veinlets are irregular, sometimes uniting with the upper secondary veins and dividing the primary areoles into two or three secondary areoles. In some cases some of the excurrent veinlets from the outermost row of areoles extend to the margin and may unite with an up-

per secondary vein on that side (Fig. 4). The areoles are irregularly formed and there is often a slight variation in the venation pattern even in the same pinna, but the typically goniopteroid pattern found in *B. subcrenata* rarely occurs. The venation is free in the attenuated apical region of the pinnae. Vegetative buds are absent on the lateral pinnae. The terminal pinna is much elongated, ribbon-like, 20 to 35 cm. long, gradually narrowed toward the apex and bearing a vegetative bud laterally on the dorsal surface of the midrib a few centimeters below the apex. The venation of the terminal pinna is simpler than that of the lateral, with rather distantly placed main lateral veins. The margin is more or less undulate, except at the apex of the pinna, where it is serrate. The outer margins of the dorsal grooves of the rachis merge with the lamina of the terminal pinna.

The fertile fronds are usually smaller than the sterile ones, being up to a meter long, of which the stipe is about 40 cm. The laminae of the pinnae are highly reduced. The larger fertile pinnae are up to 10 cm. long and 2 to 3 mm. broad, linear, with a blunt apex and parallel sides. The lower are short-stalked. The terminal pinna is coadunate, up to 10 cm. long, and often bears a vegetative bud as on the sterile leaves. Sporangia occur over all of the lower surface except on the midrib and the main lateral veins. The annulus is 16 to 18 cells long. The spores (Fig. 9) are bilateral, measuring $32 \times 42 \times 32 \mu$ ($P \times E_1 \times E_2$, exclusive of the perine), with a prominent, smooth perine which is folded into short, thin, sinuous ridges.

Bolbitis kanarensis resembles *B. virens*, but can be distinguished by its larger size, distinctive venation of the sterile leaf, and by the size and morphology of the spores (Nayar & Kaur, 1963).

BOLBITIS SEMICORDATA var. **incisa** Nayar & Chandra, var. nov.

Rhizoma breviter repens dorsiventrale, ca. 1 cm. diam., filis sclerenchymatis in pulpa centrali paucis praeditum; stipes frondium sterilium 15–20 cm. longus tetragonus, basi dense paleatus, sursum parce paleatus, sursum latere adaxiali utrinque anguste

alatus; lamina sterilis lanceolata, $25-30 \times 12$ cm., pinnis lateralibus alternis sessilibus, 6×1.5 cm., acutis, basi superiore truncata vel auriculata, margine in lobis crenatis semicircularibus incisus, supremis in pinnam paullo elongatam sub apice gemmiferam coadunatis; rhachis in latere abaxiali laeviter rotundata, in adaxiali utrinque anguste alata; venatio goniopteroides, areolis saepe bifariis serie secundaria per venulam tertiaryam venulis primariis parallelem in areolam superiorem majorem (saepe cum venula libera inclusa) et in areolam inferiorem majorem (sine venula inclusa) divisa, venis ultra seriem areolarum secundariarum liberis margine attingentibus; frondes fertiles usque ad 40×2 cm., apice obtusae, pinna terminali lateralibus simili; sporae bilaterales, perino granulato in lobis conicis rugosae.

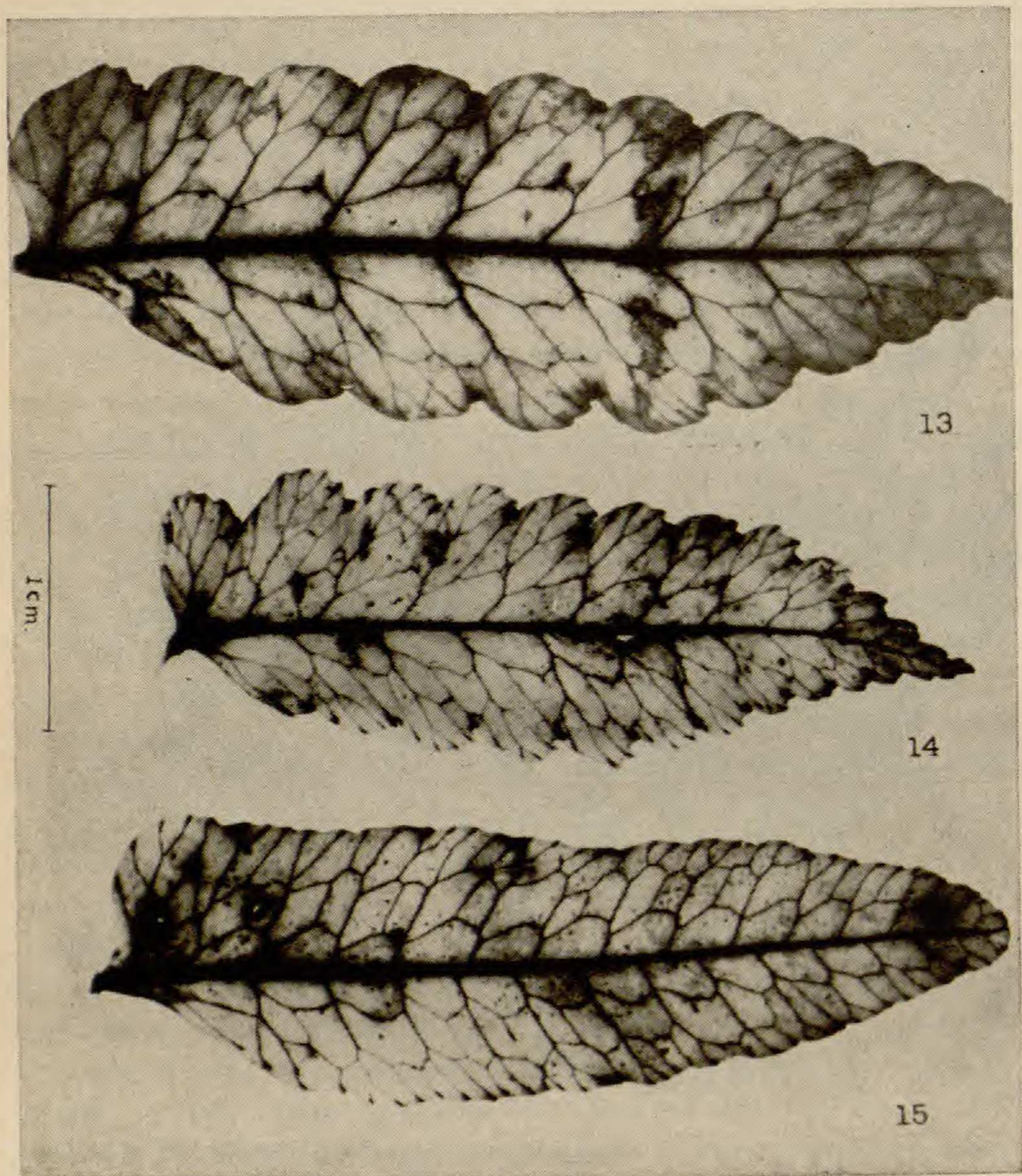
Type in the herbarium of the National Botanic Gardens, Lucknow, India, collected at Gudkewadi, Castle Rock, North Kanara, Mysore, India, alt. 400 meters, Dec. 9, 1962, *P. Chandra* 95145.

Bolbitis semicordata var. *incisa* (Fig. 12) is a small fern easily distinguished from *B. semicordata* (Moore) Ching var. *semicordata* (see Copeland, 1928) by its lobed pinnae and winged rachis. It grows in small clumps on moist, rocky substrata. The rhizome is short-creeping, dorsiventral, and tenaciously attached to the substratum by strong wiry roots. It is ca. 1 cm. thick, more or less soft and brittle, and has a few, rather thick, dark-brown to blackish, sclerenchyma strands scattered in the ground tissue. The ventral vascular strand is broadly gutter-shaped. The paleae are small, lanceolate, basally attached, and pseudo-peltate owing to the prominent overlapping basal auricles. The leaves are more or less crowded in two alternating rows on the dorsal surface of the rhizome, and associated with each leaf is a vegetative bud posteriorly lateral to the leaf-base on the side away from the median line of the rhizome. The stipe of the sterile frond is 15 to 20 cm. long, ca. 2 mm. thick, tetragonal, densely paleate at the base, and sparsely so upward. Aerating strands form prominent ridges on each side toward the base. The adaxial surface is nearly flat in the basal half, but gradually becomes strongly ridged upward, the ridge being continuous on the rachis. On either adaxial margin of the stipe is



FIGURE 12. PHOTOGRAPH OF TYPE OF *BOLBITIS SEMICORDATA* VAR. *INCISA*.

a prominent, narrow wing that tapers gradually downwards and becomes inconspicuous nearly halfway down the stipe. The wing is prominent and continuous on the rachis except for interruptions at the insertion of the lateral pinnae, and curved upward so as to form two dorsal grooves, one on either side of the median ridge of the rachis (Fig. 10). The lamina is lanceolate in outline, broadest slightly above the base, 25 to 30 cm. long, and ca. 12 cm. wide. The rachis is rounded on the lower surface; the upper has a prominent slender median ridge and two narrow grooves on each side of it. The lateral pinnae are alternate, sessile, or the lower ones short-stalked, oblong-lanceolate, ca. 6×1.5 cm., acute or rarely more or less acuminate at the apex, and devoid of vegetative buds. The bases of the pinnae are unequal. The upper base is more or less auricled and often overlapping the rachis on its lower surface; the lower base is obliquely cuneate (Figs. 13–15). The pinnae are generally reduced towards the apex of the leaf, the uppermost often being coadunate with the terminal pinna. The terminal pinna is more or less elongated, but not ribbon-like, and often bears a dorsal vegetative bud on the midrib a little below the apex. The margins of all the pinnae are prominently lobed, with the lobes nearly semicircular and the incisions between them extending nearly a quarter of the way to the midrib (Figs. 13, 14). Each marginal lobe corresponds to a main lateral vein of the lamina. The ultimate margin is crenate, each tooth receiving one of the free ending veinlets. Usually there is a prominent tooth at the bottom of the incision between the marginal lobes. This is usually red-tinged and curved towards the upper surface of the leaf, recalling the seta in some species of *Egenolfia* (Copeland 1947; Kaur, 1960; Holttum, 1954). The midrib is strongly raised on the lower surface and forms a blunt ridge on the upper surface. This ridge interrupts the lateral wing of the rachis at the base, but is not continuous with the median ridge of the rachis. The lateral veins are in subopposite or alternate pairs, ca. 5 mm. apart, distinct to the margin, and slightly raised on the upper surface. The areoles are generally in two rows on each side of the mid-



FIGURES 13-15. LATERAL PINNAE OF *BOLBITIS SEMICORDATA*. FIGS. 13, 14. *B. SEMICORDATA* VAR. *INCISA*. FIG. 15. *BOLBITIS SEMICORDATA* VAR. *SEMICORDATA*.

rib; the costal areoles are large and the second row often is divided longitudinally into two, with the anterior secondary areole sometimes having a small excurrent, included veinlet. Beyond the second row of areoles there are many excurrent veinlets that

are nearly parallel, extend to the margin, and have clavate tips. Both surfaces of the lamina are glabrous. There are a few narrow paleae on the ventral surface, where the pinnae are attached to the rachis.

The fertile fronds are seasonal, and up to 40 cm. long, including the stipe which is ca. 15 to 20 cm. long. The fertile pinnae are up to 4 cm. long and 2 mm. broad, with bluntly rounded apices. The terminal pinna is small and resembles the lateral ones. The wing on the rachis of the fertile frond is not prominent. The spores are bilateral, $25 \times 37 \times 28\mu$ ($P \times E_1 \times E_2$, exclusive of the perine), and with a prominent, faintly granulate perine which is folded into a few obconical lobes.

Bolbitis semicordata var. *incisa* differs from var. *semicordata* in the deeply lobed margins of its pinnae (see Figs. 14, 15), and in having a prominently winged rachis. Both varieties grow together in localities where they are restricted to deeply shaded forest beds, growing generally on rocky substrata or on gravelly soil, and forming small clumps.

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